CLAIMS

What is claimed is:

SUB A1

1. A synthetic multimeric biopolymer comprising a plurality of monomeric units selected from the group consisting of proteins, polypeptides, nucleic acids, peptide nucleic acids, and combinations thereof;

wherein said monomeric units are the same or different;

wherein at least one of said plurality of monomeric units comprises a binding region for an analyte; and

wherein said multimeric biopolymer changes its three-dimensional conformation in response to binding of the analyte to said binding region.

2. The biopolymer of claim 1 wherein the monomeric unit which comprises the binding region for the analyte is a protein or polypeptide.

3. The biopolymer of claim 1 wherein the monomeric unit which comprises the binding region for the analyte is a nucleic acid molecule.

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4. The biopolymer of claim 1 wherein the monomeric unit which comprises the binding region for the analyte is an aptamer.

5. The biopolymer of claim 1 wherein the monomeric unit which comprises the binding region for the analyte is a peptide nucleic acid.

6. The biopolymer of claim 1 wherein said biopolymer comprises a protein, polypeptide, or aptamer that changes its three-dimensional conformation in response to binding **of a proton to or a release of a proton from said binding region**.

7. The biopolymer of claim 1 wherein said biopolymer comprises an enzyme that catalyzes a biochemical reaction which results in the formation of protons or hydroxide ions when said enzyme binds to said analyte.

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8. The biopolymer of claim 1 wherein said biopolymer comprises

(a) a protein or polypeptide that changes its three-dimensional conformation in response to binding of a proton or a hydroxide to said binding region, and

(b) a protein or polypeptide that catalyzes a biochemical reaction which results in the formation of protons or hydroxide ions when said protein or said polypeptide binds to said analyte.

9. The biopolymer of claim 1 wherein said biopolymer comprises a plurality of proteins or polypeptides or a plurality of aptamers.

10. The biopolymer of claim 1 wherein said biopolymer comprises from 2 to 10 monomeric units.

11. The biopolymer of claim 1 wherein the analyte is selected from the group consisting of a sugar, a protein, a peptide, a nucleic acid, a hormone, a vitamin, a co-factor, an anion and a cation.

SUB A2

12. A synthetic multimeric biopolymer comprising a plurality of monomeric units selected from the group consisting of a protein, a polypeptide, a nucleic acid, and a peptide nucleic acid, wherein said monomeric units are the same or different,

wherein at least one of said plurality of monomeric units comprises a binding region for an analyte, and

wherein binding of the analyte to said binding region results in the formation of protons or the transmission of a detectable signal by the multimeric polymer.

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13. The biopolymer of claim 12 wherein said biopolymer comprises a protein or polypeptide that catalyzes a biochemical reaction which results in the formation of protons or hydroxides when said protein or said polypeptide binds to said analyte

14. The biopolymer of claim 12 wherein said biopolymer comprises a monomeric unit that transmits a detectable signal selected from the group consisting of a fluorescent signal, an optical signal, an electrochemical signal, a pressure change, a dielectric constant change, a mass change, a volume change, and a temperature change in response to binding of the analyte to said binding region.

SUB A3

15. A device for dispensing a substance in response to an analyte, comprising:

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(a) a substrate having at least one delivery chamber which contains the substance; and

(b) a multimeric biopolymer which is disposed in a channel in communication with said at least one delivery chamber or in an opening to said at least one delivery chamber;

wherein said multimeric biopolymer compres a plurality of monomeric units selected from the group consisting of proteins, polypeptides, nucleic acids, peptide nucleic acids, and combinations thereof;

wherein said monomeric units are the same or different;

wherein at least one of said plurality of monomeric units comprises a binding region for an analyte; and

wherein said multimeric biopolymer changes its three-dimensional conformation in response to binding of the analyte to said binding region; and

wherein changes in the three dimensional conformation of the multimeric biopolymer regulate the opening and closing of the channel or the delivery chamber opening.

16. The device of claim 15, wherein said device is a microchip, a nanochip, a nanovial, a microvial, microchannel, nanochannel, a microelectromechanical system (MEMS), or a nanoelectromechanical system (NEMS).

17. The device of claim 15, wherein said substance is a therapeutic material.

18. The device of claim 15, wherein the substrate comprises a porous or nanoporous material.

19. The device of claim 18, wherein said porous or nanoporous material is alumina or zeolite or titania, or silica, or zirconia.

20. The device of claim 15 wherein the monomeric unit which comprises the binding region is a protein or polypeptide.

21. The device of claim 15 wherein the monomeric unit which comprises the binding region is a nucleic acid molecule.

22. The device of claim 15, wherein the monomeric unit which comprises the binding region is an aptamer.

23 The device of claim 15, wherein said multimeric biopolymer is covalently bound to a surface which defines the channel or to a coating which is disposed on a surface which defines the channel.

24. The device of claim 15 wherein the coating is a hydrophilic substance.

25. The device of claim 15 wherein a decrease in the size of the multimeric biopolymer opens the channel or opening.

26. The device of claim 1 wherein said multimeric biopolymer is in contact with a moveable member adapted to move from a position away from said opening and a position covering said opening; and wherein the change in the three dimensional conformation of said multimeric biopolymer results in movement of said movable member.

27. The device of claim 26 wherein the moveable member comprises a hydrogel or a rigid substance.

28. The device of claim 15 further comprising an electronically conducting redox polymer in contact with said multimeric biopolymer;

wherein the multimeric biopolymer comprises a first binding region for binding to an analyte which is not a proton and second binding region for binding to a proton;

wherein binding to the analyte which is not a proton to the multimeric biopolymer and binding of the proton to the multimeric polymer have opposite effects on the three-dimensional change in conformation of the multimeric biopolymer; and

wherein application of an electrical potential to said redox polymer results in the accumulation of protons in the microenvironment of the multimeric biopolymer, or

removal of protons from the microenvironment of the multimeric biopolymer.

29. The device of claim 28 wherein the redox polymer is blended with or covalently bonded to the multimeric biopolymer.

30. The device of claim 28 wherein the redox polymer is in contact with a electron conductor.

30. The device of claim 29 wherein the redox polymer is deposited on a metal electrode.

31. The device of claim 28 wherein the redox polymer is selected from the group consisting of consisting of polyanilines, polypyrroles, polythiophenes, polyindoles, and mixtures thereof.

32. The device of claim 15 further comprising a redox polymer in proximity to said multimeric biopolymer for generating protons or hydroxide ions near the multimeric biopolymer and reversing the reaction which results from binding of the analyte to the multimeric biopolymer, wherein said redox polymer is attached to an electrode.

33. The device of claim 15 further comprising a material capable of changing its shape disposed in the channel or the opening of the delivery chamber,

said material comprising an electronically conducting redox polymer and a hydrogel;

wherein application of an electrical potential to said redox polymer results in a change in shape of the hydrogel.

34. The device of claim 33 wherein said hydrogel is selected from the group consisting of polyhydroxyethylmethacrylates.

35. The device of claim 33 wherein application of a redox polymer causes said material capable of changing its shape to shrink, thereby opening said at least one delivery chamber or channel, or causes said material capable of changing its shape to swell, thereby closing said at least one delivery chamber or channel.

36. The device of claim 33 wherein application of a redox polymer causes said material capable of changing its shape to swell, thereby opening said at least one delivery chamber or channtl or causes said material capable of changing its shape to shrink, thereby opening said at least one delivery chamber or channel.

37. The device of claim 33, wherein said material capable of changing its shape is in contact with an electrode.

38. A device for detecting the presence of an analyte in a medium, said device comprising

a) a substrate, and

b) a multimeric biopolymer disposed on said substrate

said multimeric biopolymer comprising a plurality of monomeric units selected from the group consisting of proteins, polypeptides, nucleic acids, peptide nucleic acids, and combinations thereof;

wherein said monomeric units are the same or different,

wherein at least one of said plurality of monomeric units comprises a binding region for said analyte, and

wherein said multimeric biopolymer emits a detectable signal when said analyte binds to said binding region.

39. The device of claim 38 wherein the detectable signal is selected from the group consisting a fluorescent signal, an optical signal, an electrochemical signal, a pressure change, a dielectric constant change, a mass change, a volume change, and a temperature change.

40. A device for dispensing a substance, comprising dispensing a substance in response to an analyte, comprising:

(a) a substrate having at least one delivery chamber which contains the substance; and

(b) a multimeric biopolymer and a hydrogel,

wherein said multimeric biopolymer and said hydrogel are disposed in a channel in communication with said at least one delivery chamber or in an opening to said at least one delivery chamber;

wherein said multimeric biopolymer compres a plurality of monomeric units selected from the group consisting of proteins, polypeptides, nucleic acids, peptide nucleic acids, and combinations thereof;

wherein said monomeric units are the same or different;

wherein at least one of said plurality of monomeric units comprises a binding region for an analyte; and

wherein said multimeric biopolymer releases a charged ion in response to binding of the analyte to said binding region; and

wherein release of the charged ion cause a change in the pH of the microenvironment of the hydrogel, thereby causing the hydrogel to shrink or swell.

41. A synthetic multimeric biopolymer comprising a plurality of monomeric units selected from the group consisting of proteins, polypeptides, nucleic acids, peptide nucleic acids, and combinations thereof;

wherein said monomeric units are the same or different;

.wherein at least one of said plurality of monomeric units comprises a binding region for an analyte; and

wherein said multimeric biopolymer amplifies changes in its three-dimensional conformation in response to binding of the analyte to said binding region.

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SUB A4

ADD A5